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信息時代的新管理典範

NEW MANAGERIAL PARADIGM IN THE INFORMATION AGE

主编:林子铭
陈荣秋
孟二陵

Co-editors: Jimming Lin
Rongqiu Chen
Erling Meng

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Excellent Paper Awards

The Ratios of Marketing Expenses to Sales Revenue and The Patterns in China's Manufacturing Industries

Research on The Correlations Between The Strategic Factors and The Profitability in China's Manufacturing Industries

The Structure and Characteristics of The Labor Employment and Their Income in China's Manufacturing Industries

The above three papers are altogether co-authored by Zhilong Tian and Xixian Cai in Huazhong University of Science and Technology, and Myron J. Gordon in the University of Toronto.

Capacity Distribution Oriented MPS Development: An Integrated Method for Job Shop

By Shihua Ma, Rongqiu Chen and Xianyun Wang in Huazhong University of Science and Technology.

An Experimental Study of The Effects of Napping on Attention

By Jianqiao Liao in Huazhong University of Science and Technology.

Status Quo, Improvement and Productivity of China's State Enterprises

By Difang Wan and Yingluo Wang in Xi'an Jiaotong University.

Horizontal Mergers in an Open Economy

By Hongmin Chen in Shanghai Jiaotong University and Anming Zhang in the University of Victoria.

A More Generalized Decomposition Method For Linear Programs.

By Boxiong Lan in Tsinghua University and David Fuller in the University of Waterloo.

Where We Are and Where We Go: Analysis of The Management System and Managerial Behaviour of Chinese State-Owned Enterprise

By Youmin Xi in Xi'an Jiaotong University.

Technology Transfer Via Foreign Investment

By Xingming Wang and Fudong Zhu in the People's University of China.

A Message From Professor Jimming Lin

This year marks an extraordinary year for NSP members. Thanks to the idea of Dean Rongqiu Chen, we planned a year ago to hold the fourth annual conference on a tour boat along Chinese famous Three Gorges. As we all know that Chinese government is determined to utilize the enormous hydropower by building a huge dam and make the Three Gorges a huge reservoir. There are controversial point of views related to managerial, economical, social and political issues, such as energy resource, cultural heritage, environmental impact, relocation of inhabitants, etc. With this special arranged conference along the Three Gorges, we will be eye-witnessing this grand historical event.

NSP members continue their academic development in the international exchange. Professor Bo Wang has a finished one year visit in Concordia University and returned to Tianjin University. Professor Lannan Chen and Professor Shinong Wu also visited two top American universities for one year and returned to Xiamen University.

Professor Boxiong Lan who major in management science has accomplished his Ph.D from the University of Waterloo and now returned to the School of Economics and Management in Tsinghua University. Professor Jianqiao Liao continued his research on Chinese napping behaviour and he probably is the only expert in this area. He finished his Ph.D from the University of Toronto five years ago and returned to Huazhong University of Science and Technology.

I am especially delightful to find out that at least five papers are generated from last year's NSP research proposals. The financial support from NSP to the research is noticeable, especially the number of papers and proposals submitted are both increasing substantially each year. Professor Zhilong Tian has done excellent research work on the subject of China's manufacturing industries under the supervision of ex-dean Cai Xixian in Huazhong University of Science and Technology and Professor Myron Gordon in Toronto University. His three papers submitted are all evaluated as excellent.

Although we have established newsletter to publicize NSP member's activities, however, most of the members prefer to keep very low profiles. I noticed that some of the members have accomplished something last year worthwhile mentioning. For example, Liu Jinlan in Tianjin University, has published at least four journal papers in Journal of System Engineering, Journal of Industrial Engineering and Engineering Management, Journal of Decision Making and Decision Support Systems, and Information System Engineering out of the seed money supported by NSP research fund. Professor Yuan Rui Zhan will publish a book entitled "Theory, Methods and Application of Influence Diagrams," by The Press of Tianjin University in 1995. Professor Du Gang has published papers in the Journal of System Engineering, Journal of Tianjin University, Journal of Decision Making and Decision Support Systems, and a book entitled Hierarchical Optimization: Theory and Application by Science and Technology Publishing House in Tianjin. If you have something worth of mentioning, please inform Professor Jianqiao Liao who is currently the editor the NSP

newsletter.

Finally, allow me to wish you all enjoy this peculiar conference trip. Relax, sip a cup of drink, behold the picturesque scenery, and read those famous Chinese ancient poems regarding the beauty of Three Gorges. Isn't that Li Bai in Tang Dynasty once said in his poem: " Oh, my friend, fill the cup of life with happiness and enjoy it while you can. Don't be so lonely to face the moon with your empty cup. Haven't you see those who are young in the morning, yet their hairs turned to gray in the evening?" Alas, who said that we guys in management are lack of talents in classics and have no emotion to cultural relics?

Can We Cope With The Coming Crisis of Mass Extinction in The Information Revolution?

Jimming Lin
Faculty of Administration
University of Ottawa
Ottawa, Ontario
Canada, K1N 6N5
Internet: jlin@im.mgt.ncu.edu.tw

Recent fossils findings of the giant dinosaurs, the once mighty rulers of the earth, caught world-wide attention and inspired human imagination. For many years, Canadian and Chinese geologist cooperated to solve the mystery of this once powerful animals. The new findings from Inner Mongolia and from Zigong city of Sichuan province in China and those counterparts in Alberta, Canada will provide us new evidences so that we can understand more about those enigmatic creatures.

One mystery always arouses our interest — why did those creatures suddenly disappeared world-wide in the same time regardless where they lived? According to Darwin's evolution theory, i.e. the survival of the fittest, dinosaur became extinct mainly because they could not adapt to the then living environment. Some gene scientists even proposed that the quality of the dinosaur's gene was deteriorating over many million years. However, judged from the shape-evolving skeletons, dinosaurs were really very successful species and some of them, such as Tyrannosaurus, had been evolving into very efficient and forceful animals. While hominoid appeared on the stage of the world for around five million years before present, the dinosaur had been roaming on the globe for at least around seventy million years before they all "suddenly" disappeared at 65 million years before present — a critical time when geologists classified it into the end of Cretaceous Period.

What has caused such a grand-scale mass extinction during that short period? Will such disaster destroy us, the only thinking living beings ever existed on earth, in the near future?

Mass Extinction and The Survival of the Fittest

In fact, the case of dinosaur's extinction is not an exception in the earth's history. Anthropologists have noticed the repetitive mass extinction of living things judging from the fossil records. At least there are six major noticeable mass extinctions happened at the end of the following eon: the Cambrian, Ordovician, Devonian, Permian, Triassic, and Cretaceous period. The pattern clearly shows that during each transition period, 25 to 50 percent of all fossil families became extinct at the end of that period and then followed a time-span of 3 million to 8 million years of mass replacement — recovery of many new evolving groups — occurred at the succeeding period (Erwin and Kauffman, 1994). As each family of living things

contains many species, the extinction rate at the species level is appallingly higher– more than 90% (The Volume Library I, 1992, p.569).

There are quite a few hypotheses to explain these recurrent mass extinction: (1) the periodic appearing of ice age caused sea level to retreat or rise, thus stirred up the stability of the shallow water ecological systems; or (2) the volcano eruptions caused by intensive crust movements may block sunlight, thus cooled the temperatures, and caused the appearance of ice age. Furthermore, the smokes may blackout the sunlight which was necessary for the photosynthetic plants, thus reduced the food and oxygen supply; or (3) the comets and meteorites may hit on earth, caused the change of earth's orbit or the explosion may stir up a large amount of dust into atmosphere that blocked the sunlight worldwide.

A few examples of extinct species other than dinosaurs can illustrate this fearsome phenomena. Based on his life-long study on more than two hundred Ordovician (started from 500 million years ago and lasted for 77 million years) brachiopod genera collected from over 40 localities of six palae-biogeographical regions in China, Liu (1984, 1987, 1989) pointed out that even in the nearly 77 millions span of Ordovician, there were three stages of each is about 25 million years. Each stage included two interrelated processes—unceasing diversification at the early stage and rapid extinction at the late stage. In the stable period of each stage, the brachiopod cardinalia did not revealed a prominent evolutionary trend, but continuously showed a prosperous and stochastic diversification. However, across the transitional period between two stages, the cardinalia obviously was forced to undertake a clear dynamic selection and leapfrog to give rise to new super-families. Liu furthered divided biotic evolutionary processes into three interrelated developmental levels on the time-space scale: (1) molecular level, i.e., the process from such contingent mutation caused by base-pairs replacements of DNA and then by the gene recombination; (2) population level, i.e., the evolution from replacement of gene frequency caused by the unstability of gene fluctuations from the small isolated population; and (3) biosphere level, i.e., the evolution from the globally synchronous alternation of transgression periodicity, lithofacies cycle, and ecosystem replacement. The third level of globally dynamic selection usually is the prime factor of higher-level selection and mass replacement of organic groups.

Trilobite, another popular novice fossils collection, also shows the same pattern of life and death in another period. The million year's of rise and fall of the now extinct trilobite family shows an interesting example of how life struggles for the survival of the fittest for most of the time, yet the sudden jerk of fate always plays a critical role in deciding the final destiny of a whole group. The trilobites had developed into various forms in the Paleozoic era began some 570 million years (The World Around US, 1984, p.2366—2367) which is divided into six sub-geological periods: the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian. The trilobites flourished in the early Cambrian era, yet completely wiped out at the end of Permian. At the end of Cambrian, a geological upheaval created the rise and fall of sea levels and changed macro weather systems. Scientific evidences allowed

the geologists to inferred that sea level fell sharply during this period and anthropologists have found that almost 75% of trilobite families were disappeared. However, with the surviving families in the succeeding Ordovician period, several new trilobite families appeared. Again, at the end of Ordovician, trilobites were losing more than 50 % of their families. Then during the Silurian period, trilobites were becoming less numerous, but still locally abundant. In Devonian, trilobites continued to decline in numbers, yet the largest of all various trilobites were evolved during this period. Some even reached 70 centimeters long. Again, at the end of Devonian, trilobite lost more than 50 % of their families. Yet, the end of Permian period marked with the most severe mass extinction. More than 95% of all species, including trilobites, completely disappeared. Therefore, the fossils of trilobites are used as "index fossils" to date specific strata of sediment if they are found in it (The Volume Library I, 1992, p.565). Although we can infer from the geological study that the abrupt change in the macro environment reprogrammed the equation of survival suddenly, we can not answer the question why some kinds of trilobite were extinct while other types survived and evolved into new kinds. Not enough evidences, except the exterior shapes of various trilobites marked by the fossils, can assist us to answer this vital question.

The mass extinction at the end of Permian period was so severe that there were very little life forms at the very beginning of Triassic period. However, ammonoids, after coming to almost extinction, rapidly evolved and diversified during Triassic period into more than 400 genera (ibid., p.574), yet by the end of the Triassic period, the ammonoids were reduced to only one. However, ammonoids continued to exhibit the same pattern of near mass extinction appeared at the end of each period and mass replacement at the very beginning of each following period until the end of Cretaceous, during which time about 75% of species were wiped out, including ammonids and dinosaurs (ibid., p.576).

With the giant dinosaurs completely vanished, mammals evolved and flourished in the succeeding Tertiary period. Then, in the Quaternary period which started from 1.8 million to 1.7 millions years before present, Hominoid gradually evolved into a very successful intelligent living beings and dominated the earth ever since.

The main characteristics that put human being far ahead of all other living creatures is the size of the brain. The following section will review the evolutionary changing capacity of this wonderful organ. Based on this understanding, we can explore how we can best adapt our brain with growing computer capacity to deal with the coming crisis brought up by the information revolution.

The Evolving Human Brain

The weight of stegosaurus's brain is only less than 1/20,000 of its body weight, while that of stenony-chosaurus's is less than 1/500. In comparison, human brain weighs about 1/50 of its body weight (Parker, 1993, p.26). In fact, although mammal's brain/body ratio is generally higher than that of other animals, the human brain is

largest of all land mammals in terms of the brain weight relative to the body weight (Ornstein, 1991, p.45).

Primate brains, as compared to other animals, are comparatively larger and heavier and are more complex in structure. Wilson and Cann (1992), two geneticists, suggested that modern humans descended from a race who lived in Eastern Africa only 200,000 years ago and then moved slowly into other places, they claimed that modernman group replaced the archaic humans. Fossils remains found in Israel suggest that Neanderthals and modern humans co-lived for 40,000 years without evidence of interbreeding. On the other hand, Thorne and Wolpoff (1992), two anthropologists, advocate that humans originated in Africa and left Africa at least one million years ago. They proclaimed that Homo Sapiens emerged gradually throughout the world and then gradually evolved their modern forms at the same time in every part of the world.

Table 1. Hominoid Brain Capacity

Specie	Time Frame (years before present)	Brain Capacity(c.c.)
Chimpanzee	300-400*1.	
Australopithecus	3-4M	430-550*1;380-530*2;450-500*3;435-700*4.
Homo habilis	2.3-1.3M	500-800*1; 580-775*2; 650-800*3.
Homo erectus	500K-1M	700-1,250*1; 775-1,225*1 .
Chinese H. E*5	000K-700K	1,000*1; 850-1,300*4.
Javanese H.E.	500K-1.3M	900*2; 775-990*4.
Homo sapiens		
Neanderthal	60K	1,500; 1400*1.
Cro-Magnon	50 K	1,450.
Modern Man	0	1,000-1,800*1; 1,000-2,000*1.

Legend:

*1:Johanson and Edey(1982); *2:Haviland(1991); *3:Merriman(1989), *4:Chang (1986). *5: H.erectus in Zhoukoudian are dated 500,000 years old; while the remains in Lantian are 700,000 years B.P. The Kung-wang-ling reamins, probably from females, were the earliest hominid fossil found in China and the cranial capacity is 780 c.c.

The prehuman species were evolving for several million of years before the modern human species appeared on the stage between 50,000 and 100,000 years ago. Archeologist dated the hominid remains and classified the stage of human evolution. For example, evidence shows that linear evolution relationship connecting from Australopithecus (ape man), to Pithecanthropus erectus (original man), to Home neanderthalensis (old man), and to Homo sapiens (new man). Australopithecus,

appeared around 1 to 4 or 6 millions ago millions years ago, had the cranial capacity of 380 c.c. to 530 c.c. and was the earliest fully bipedal hominid that has ever found. Most recently found earliest human remains were dated around 4.4 million years ago and was named "Australopithecus ramidus" (Fischman,1994). Their brains were little bigger than those of gorillas, but in terms of brain-to-body ratio, they are midway between apes and humans (Merriman, 1989). Those of Homohabilis from East Africa which lived between 2.3 to 1.8 million years ago posses the cranial capacity of 580 to 775 c.c., while Homo erectus which immediately preceded Homo Sapiens has the capacity of 775 to 1225 c.c. (Haviland, 1991, p.131 — 132). Refer to table 1 for comparison.

Human brains reach its mature stage around 100,000 years ago. For example, Cro-Magnon, such as Qafzeh hominids, had lived about 80,000 to 100,000 years ago and their brain sizes are no less than those of us today, except that the shape of the skull is changed (Bar-Yosef and Vandermeersch, 1993). Haviland (1991, p.173) alsopointed out that Neandetals who lived in Europe and West Asia around 100,000 to 30,000 years ago and Cro-Magnon man who lived in Europe somewhere around 35,000 years ago had a brain capacity of 1450 c.c. which are virtually the same as ours today. However, the structure of Neandetals' brain skull was still "primitive looking," i.e. comparatively flat and protruding outward toward eyebrow area, and the mid-facial projection of noses and teeth (Newton Magazine, 1994). Yves Coppens, the chair of paleoanthropology and prehistory at the College of France in Paris, suggested that human brains evolved not only in terms of size, but also in terms of structure (1994). For example, the cranium of Homo Erectus had a low vault, and the head is long and narrow. Its width was comparatively longer than its height and the greatest width was set at the base, while the modern man's skulls are comparatively higher than wider, with the widest dimension in the area above the ears (Haviland, 1991, p.156). Nevertheless, the brain size has been stabilize at the level for at least 100,000 years or so. One possibility of such stabilizing selection is that human's female birth canal which pass the structure of pelvis is not adequate for the birth of larger—brained offspring (Haviland, 1991, p.62). Again, judged from the size of the brain depicted in Figure 1, the evolution process of human's brain does not proceed in

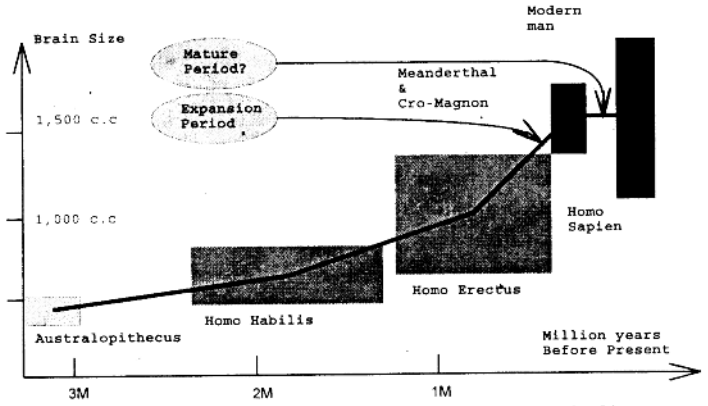

Figure 1: The Evolution Process of Human's Brain Size

constant change, but rather shows a long period of stability disturbed by sudden environmental change and then new adaptation is required. Postulating the relationship between the bipedalism and maintaining low blood circulation into the cortex, Fialkowski (1987) proposed a theory to explain the reason for a sudden enlargement of brain size long before history.

The Complex Structure of Human Brain Today

Today human brain is composed of a trillion cells in which 10 to 100 billion of them neurons linked with 10,000 synapses and each neuron is wired to one thousand other neurons in complex networks to support the intelligence (Fincher, 1984, p.40; Fischbach, 1992, p.51). The brain is the most expensive organ for human being. The weight of a brain is approximately 2% of the total body weight, yet it consumes inproportionaly large supply of oxygen, 20% of the total amount carried by the blood. Compared to chimpanzees, human brain size and neurons sensitivity is larger, and both contribute to a larger number of neurons — 30 billion neurons in human as compared to 6 billions in chimpanzees (Ornstein, 1993, p.63). C. Judson, a pioneer US neurologist, once calculated that if only one million of these neurons were simply reacts in a two-by-two relationship, the possible combination would reach the astronomical number of 102,783,000. The number increase unceivably large if we consider that the number of neurons are over 10,000 times a million, and the ways of combination of neurons are various (Encyclopaedia Britannica, 1984, Vol.4, p.472).

Human brain's functions are highly developed not only of motor and sensory of its own body, but also developed specialized functional area for various highly intelligent activities. Intelligent activities, such hearing, seeing, speaking, generating words, long-term memory, emotion, are functioned by various part of the brain. The cerebral cortex, the outer layer of the brain which is deeply convoluted surface region of the brain, is developed into the mental activities of planning, learning and thinking and is highly related to intelligence. The area of this surface for man is equivalent to 4

pages of typing page, while for chimpanzee it would be one page, for monkey it would be the size of a postcard, and for a rat it would be the size of a postage stamp (Calvin,1994). Furthermore, most of us divide our brains in two parts, the right hemisphere perceives thing in a holistic and simultaneous approach, while the left side excels in abstract and symbolic information processing. Evidences showed that the prefrontal lobes of the cerebral cortex performed the function of working memory. Facts and figures hold associate memory in long-term storage. (Goldman-Rakic, 1992). Furthermore, human brain stores permanent memories in terms of their meaning, retaining concepts and relationships instead of words (Fincher, 1984, p.84). Long term memory seems stored in a specific part of the brain and usually takes a longer period of time to imprint information from short-term memory into long-term memory. Our brain also will index each chunk of long-term memories with retrieval cues in order to cross-referencing them effectively like a library (ibid., p.86).

With the development of human's brain, we can establish complex social organizations so as to achieve a very successful form of collective survival while written civilization can assist us the accumulate knowledge and experience so that each generation can quickly learn from previous accumulated wisdom and continue to develop the complex knowledge required.

Human Survival in the Information Revolution

With our amazing brains, we gradually become the master of the earth with all kinds of production tools we invented. In fact, we human being are the only animal that dominantly changes the environment we lived. With the flint, spears and other various stone tools, pre-history human can survive by hunting for animals food without fierce teeth or sharp craws. Moreover, while human's brain is evolving larger, their teeth are evolving smaller and smother. They are so successful with the tools they invented that they might be responsible for the extinction of some large mammals. For example, at the end of final Ice Age, between 5,000 to 10,000 years ago, many largeplant-eating animals and predators became extinct. It is very likely that human hunters have become so efficient, that they did not only exterminated those mastodons and woolly mammoths, but also thus exhausted the food supply of saber-toothed cats and prehistoric wolves. Also evidence showed that Paleoindian, the inhabitants of North America around 12,000 years ago, with efficient hunting spears tipped with distinctive fluted points, and by driving large number of animals over cliffs, they had killed large amount of bison more than they could consumed (Haviland, 1991, p.194 — 195). The population during this stage had grown from 150,000 to five million in around 100,000 years ago. Gradually human settle down with agricultural techniques for a few thousands and the population increased from five million to 500 million. However, it is the industrial revolution that started from 200 years ago that progressing technologies allow us to create new medicines that can effectively control the disease, prolong our life span, reduce the mortality rate of babies, produce large quantities of food and shelters with less labor, and mass manufacture large volumes of cheap consumer goods. As a result of this great success,

human population exploded exponentially from 500 million to 5.6 billion within a very short period of geological time (Kates, 1994). The number of human population has been steadily grow at a very slow pace until recently when the pressure from natural selection is subdued to the pressure of man-made selection. Ironically, human's success is so immense that they endanger all other living animals and create the worldwide environmental crisis. The total number of human population has reached more than five billions and there is no sign of decelerating in the near future except those few highly developed nations and possibly China. In fact, human races is so successful that deteriorating biological environment caused by today world human over-population and possible extinct of endangered wild animals are two main concerns of the world.

In comparison, we could see industrial revolution and information revolution will quickly changed the equation of species' survival on earth just as the meteorite once did when it hit on the earth 65 million years ago. During 1770 to 1780, British cotton textile industries started the process of industrial revolution by adopting new machines that changed the production efficiencies. The steam engine by the end of 1700's had provided the power for the 1800's industrializing needs. Suddenly, human labor is inferior to machine in terms of economic output and again five thousand years of experience accumulated from agricultural civilization is not adequate for human being's survival. Such impact of technological progress on economic power created imbalance between social classes and among nations. As a result, social-economic unrest and international wars appeared frequently and continued until today.

Furthermore, as human use coal to supply the major required energy in industrial revolution and the burning of coals pumps a large quantity of carbon dioxide and pollutants into the atmosphere, human affected the ecological systems in grand scale that many living things today are greatly affected. For example, the lighted colored peppered moth can well be camouflaged in the light-colored tree bark in the past. However, industrial pollution darkened the tree trunks and thus revised the traditional natural selection to favor the dark-colored moths because they can be protected from the attention of foraging birds (The World Around Us, 1984, p.159).

As evolution is literally is interpreted as the change to progress, many people believed that evolution is a destiny to progress for the better and we as the highest intelligent beings are destined by the Creator to steward the planet. However, Gould (1994) examined the detail of fossil records of various eon, he argued that there is no proof that the history of life on planet is progressive and it is impossible to predict the trend of evolution based on status quo. The simple fact from the evolution is that the earth's creatures have evolved through a series of unpredictable events. For example, if a large extra terrestrial body had not hit on the earth 65 millions years ago, Gould argued, the powerful and roaming dinosaurs would still be continuous to be the dominant creatures on earth and mammals would had little chance, let along human beings. Now, if we look back into the time of 15th century, are the divergent historical development and its consequent impact of the great navigators, Columbus in Europe and Cheng He in China, is partly due to destiny rather than some historical factors (for a full discussion, refer to Lin, 1994)? Can we view industrial revolution as

an unprepared disaster for some older civilization who had been so successful maintaining the stability of its cultural characteristics while failed to diversify their survival strategy in the strange new environment? In other words, they failed to innovate in the sudden change of survival equation?

The price for the failures of China's and India's to respond to such pressure of near mass extinction is too high to ignore. As Economist (1994, October 1st, p. 9 in the survey) pointed out that before the industrial revolution in 1750, the third world, principally China and India, accounted for 73% of world manufacturing output. After European countries utilized the manufacturing power generated by the steam engines, the third world manufacturing output steadily declined to just over 60 % in 1930s. Since China and India were left behind by European industrial revolution, its share of world's output plummeted to just 8% by 1913, while top 20 countries manufactured world output jumped from 30% in 1830 to almost 80% by 1913. Although China has been the world's largest economy for most of the recorded history and had the highest income per head until around 1500 and was still the biggest in total until 1850, when it was overtaken by Britain. It is only after World War II, the modern available higher education and international global cooperation in joint venture has effectively transfer the technologies from developed nations to less developed ones. With the assistance of modern mass media, the transmission rate is accelerating. As the Economist pointed out in a special survey (October 1st, 1994, "The Global Economy War of the Worlds") by saying:

"Over the years, the pace of economic development seems to have quickened. The industrial revolution in the 18th and the 19th centuries was a slow affair compared with growth rate today. Thanks to better communications, technology is now diffused more quickly than in the past. After the industrial revolution took hold in about 1780, Britain needed 58 years to double its real income per head; from 1839 America took 47 years to do the same; starting in 1885, Japan took 34 years; South Korea managed it in 11 years from 1966; and more recently, still, China has done it in less than ten years (p.6 in the Survey)."

However there is a negative side of the successful stories. Although there are many countries show promising and prosperous economic future, they are usually paying an unpleasant price for the economic development. The deteriorating quality of life of those developing nations — i.e. air and water pollution, traffic congestion, high price of land, unfair distribution of wealth and political power, congested urban living quarters, and high crime rate — is imposing a great stress on the human living in it.

The violent human nature is still deep implemented in our brain. In the case of Peking Man, the brain capacity reach an average of 1,075 c.c., their life span is pretty short. Forty percents died before the age of fourteen, while less than 3% lived more than 50 years (Chang, 1986, p.44). Judging from the fracture of their bones, many of them were killed not by other fierce carnivore animals, but by their own race. We are not so distant from Peking Man in terms of this. Today, although the genes of all human races are 99% similar, large scale of genocide are seen in many parts of the world, such as the cases in Cambodia, Rwanda and former Yugoslavia. Furthermore,

the easy accessed weaponry technology has allowed the terrorists to threaten large number of innocent public. Recent cases of Federal Building explosion in America's Oklahoma city and poisonous gas in Japan's subway stations are only two recent well-known cases. With the collapse of the former Soviet Union, the once well -- controlled nuclear weapons are very likely available in the hands of international terrorists. The rule of the evolution is becoming the survival of the most wicket, not the strongest. Human being create a self-destructive force of made—made selection. Observed the documented signs of changing climate and world's over-populated human race, Ward (1994) warned that another mass extinction has already begun on our planet. Will we, regardless of our diverse racial background, be able to exert our intelligence collective in order to survive this eminent man-made disaster or will we be extinct just like trilobite 250 million years ago and dinosaurs 65 millions ago?

Many anthropologists point out the similarity of biological evolution and cultural evolution (Haviland, 1991, p.63). Cultural evolution is promoted by human civilization. The enormous increase in complexity of current technological environment certainly will have a measurable physical impact on our brains. However, the modern industrial revolution only occurred in a few hundred years which was negligible in the biological evolution time scale. The rate of technological change far supersede the speed of the biological change.

Human being is the only creature on the earth that can explore the meaning of its existence, control the living environment, or kill each other in a large scale. Human appearance on the stage is still very short in comparison to earth's other once prosperous creature, such as dinosaurs which roamed on this planet from 200 to 65 millions ago,. Dinosaurs have evolved very successfully in the time of Jurassic and Cretaceous Age, but possibly was genocided by an unexpected collision of an celestial body on earth in the early summer days of some 65 millions ago. Today, other than any celestial body, it is the human beings that may genocide themselves. For example, the accumulated nuclear bombs worldwide can killed world's human beings many times and such destructive weapons may be accessible by the terrorists soon. The green house effect which caused by the overpouring of carbon dioxide into the atmosphere may warm up global weather system and again may change the world's ecological systems. The problem of over population may push the limit of the land, as a result famines and contagious diseases may be imminent. Here are just a few of those world problems that are threatening our existence. On top of those critical issues, what will the coming information revolution do to us?

The integration of computers and telecommunication certainly is one of the major force of information revolution that we are experiencing today. After all, computers, the think machines, will make the human brains not so unique any more. Can we survive, evolve, adjust and maintain our unique humanity with our intelligent bio-synthesis of brains and technology? The potential impact of information revolution on us certainly has no less degree of disturbing factors of political revolution like French Revolution, and thus needs to be managed carefully (Kaye, 1994). Looking back into the evolutionary history of human race, the technological improvements in hunting and cooking reduced the selective pressure favoring massive

and robust bodies and strong chewing muscles and large teeth (Haviland, p.184), what will the technological breakthrough of computers and telecommunications will affect our long-term evolution?

Our biological features evolved to the gradual subtle changes by the principle of the "survival of the fittest." However, suddenly radical change may disturb the process of evolution and drastically change the equation of survivals. Since our brain was almost fixed in size long before the beginning of our written civilization, it is important that we learn the way to adapt ourselves to short-term changes (Ornstein, 1991, p.5). The emerging information revolution caused by the marriage of computers and telecommunications that will disrupt our social, political and economic systems may be deemed as another major sudden impact that will affect out condition of survival. Ornstein (p.6) has elucidated this point: "we would look at current failures in education, in judgment, in politics not as failures of rationality or of cultural literacy but as failures of adaptation." Although computers will assist human being to process complex data in order that they can efficiently manipulate production and consumption information, human's limited brain will find it difficult to cope with information explosion and information anxiety caused by such change.

Computer systems would assist our adaptability in the following positive ways:

1. Assist us to stored high density of useful information in a condensed media, such as CD.
2. Learning new experience fast with virtual reality.
3. Expert systems will assist us to employ the intelligence of many other expertise quickly.
4. The cyberspace created by Internet will allow us to collectively share intellectual activities never seen in history.
5. CAI (computer-aided instruction) will encourage life-long learning. Learning is becoming more individualized experience.
6. Distant learning is available for disadvantaged groups. FTP (file-transfer protocol) allows people to transmit large amount of research information at the fingrt tips, while WWW (world wide web) allows users to access various multimedia information across the continents and oceans.
7. GUI (graphical user interface) will not only make computers much easy to use, but also reduce the need of short-term memory. Computer can store short term information required to accomplish out tasks. For example, Microsoft's Window system provides the friendlier memory aid which is much easier to use than the command driven systems.
8. When the society is aging, the senior people can access the necessary information from the terminal point available at home, so that they can continue to contribute their mental value to the society.
9. Information highway can offer social assistance to the disadvantaged groups and support quicker social decision making process via information highway.

However, computers and telecommunications can also affect us negatively. Listed below are some of the potential threats.

1. Alienation of social contact which makes us so distinct.

2. Information terrorists and hackers may sabotage our important information in airports, banks, government agencies, and hospitals through networks.
3. Information overload with junk information.
4. Abuse of information technologies by dictators.

Whether we can master information revolution will largely depend on our capability to innovate with the computers and telecommunications. Erwin and Kauffman (1994) recently studied the long lasting winner after each mass extinction and concluded that "merely survival rarely guarantees evolutionary success; the post-extinction recovery process seems to hold the key. The prize will go to the group that able to diversify quickly and to fill ecological niches left empty by the extinction and displacing other survivors to create a new ecological order (p.28)." Diversify is just another word for innovation. While diversity is driven by gene's stochastic mutation and natural cruel selection, innovation can be planned, managed and motivated.

With the computers, the importance of drill and practice in education may be lower. For example, it is unnecessary to spend so much time for a Chinese elementary student to practice writing beautiful Chinese characters if they can access desired artistic fonts available in the Chinese word processing systems. The skill of using a Chinese word processing systems might be more important than the skill of mastering a Chinese thrush. Chinese thrush is just a word processing system invented in the agricultural society after all. By the same argument, the skill of applying the mathematical models might be more important to most of the students as compared to drilling for the speed of using abacus?

Human's evolution has extended the time of their offsprings to reach puberty in order that they can learn from the complex accumulated knowledge. In order to learn from the massive amount of knowledge, from about age three of four to about thirteen in many societies, children undergo an intense indoctrination and memorization (Ornstein, p.264). Such pressure on children's learning is really serious in Far Eastern societies (Lin, 1994). With the explosion of new information, obviously twelve years of compulsory learning may not be adequate for the future generation. Can we modern human still adapt ourselves to modern complex society with the mindset of a hunter or a farmer? Research indicated that early development of childhood, including the education at home and preschool, will develop each mind conditioned to the specific environment for survival (Ornstein, 1991, p.113—138). In order to survive in the new revolutionary information age, what are the major skills required for students? Can we teach the students about critical thinking, flexible adaptability and motivate them to innovate? If we can not cope with such challenge, the intelligent machine will overtake us someday. Many people will lost their jobs because their work may be replaced by the intelligent machines. The pace of evolving thinking machine is much faster compared to our biological evolution. Ten years ago, there is only a handful computer virus, today there are more than five thousand. The power of the CPU in PC is "evolving" astonishingly just within a few years and there is no sign of stopping (refer to Figure 2).